

- 1    1. An electro-absorption modulator comprising a semiconductor layer having an  
2    electrically controllable absorption, a material composition of the semiconductor  
3    layer being chosen so that the semiconductor layer is substantially transparent to  
4    light propagating though the semiconductor layer when a substantially zero or a  
5    reverse bias voltage is applied across the semiconductor layer at operating  
6    temperatures of the electro-absorption modulator that are substantially greater  
7    than 25 degrees Celsius.
- 1    2. The electro-absorption modulator of claim 1 wherein the semiconductor layer  
2    comprises a multi-quantum well layer.
- 1    3. The electro-absorption modulator of claim 1 wherein the semiconductor layer  
2    comprises a bulk semiconductor layer.
- 1    4. The electro-absorption modulator of claim 1 wherein a wavelength of the light  
2    propagating though the semiconductor layer is substantially 1310nm.
- 1    5. The electro-absorption modulator of claim 1 wherein a wavelength of the light  
2    propagating though the semiconductor layer is substantially 1550nm.
- 1    6. The electro-absorption modulator of claim 1 wherein the material composition of  
2    the semiconductor layer is chosen so that the semiconductor layer is substantially  
3    transparent to light propagating though the semiconductor layer when a  
4    substantially zero or a reverse bias voltage is applied across the semiconductor  
5    layer at operating temperatures of the electro-absorption modulator that are  
6    substantially greater than 35 degrees Celsius.
- 1    7. The electro-absorption modulator of claim 1 wherein the material composition of  
2    the semiconductor layer is chosen so that the semiconductor layer is substantially  
3    transparent to light propagating though the semiconductor layer when a  
4    substantially zero or a reverse bias voltage is applied across the semiconductor  
5    layer at operating temperatures of the electro-absorption modulator that are

6 substantially greater than 45 degrees Celsius.

1 8. The electro-absorption modulator of claim 1 wherein the material composition of  
2 the semiconductor layer is chosen so that the semiconductor layer is substantially  
3 transparent to light propagating though the semiconductor layer when a  
4 substantially zero or a reverse bias voltage is applied across the semiconductor  
5 layer at a maximum operating temperature of one of the electro-absorption  
6 modulator or a laser that generates the light.

1 9. The electro-absorption modulator of claim 1 further comprising an electronic data  
2 modulator having an output that is electrically coupled to a modulation input of  
3 the electro-absorption modulator, the electronic data modulator generating an  
4 electrical AC modulation signal having a peak-to-peak voltage amplitude that  
5 changes an absorption edge of the semiconductor layer, thereby changing light  
6 transmission characteristics of the electro-absorption modulator.

1 10. The electro-absorption modulator of claim 9 further comprising a thermal sensor  
2 that is in thermal communication with at least one of the semiconductor layer of  
3 the electro-absorption modulator and a laser that generates the light.

1 11. The electro-absorption modulator of claim 10 further comprising a temperature-  
2 driven controller having an input that is electrically coupled to the thermal sensor  
3 and an output that is electrically coupled to a DC bias voltage control input of the  
4 electronic data modulator, the temperature-driven controller generating a signal  
5 that causes the electronic data modulator to change a DC bias voltage of the  
6 electrical AC modulation signal.

1 12. The electro-absorption modulator of claim 11 wherein the temperature-driven  
2 controller includes a processor that uses a look-up table to determine the DC bias  
3 voltage.

1 13. An electro-absorption modulated laser comprising:  
2 a) a laser that generates light at an output; and

- 3           b)     an electro-absorption modulator comprising a semiconductor layer that is  
4                 optically coupled to the output of the laser, the semiconductor layer  
5                 having an electrically controllable absorption, a material composition of  
6                 the semiconductor layer being chosen so that the semiconductor layer is  
7                 substantially transparent to light propagating though the semiconductor  
8                 layer when a substantially zero or a reverse bias voltage is applied across  
9                 the semiconductor layer at operating temperatures of the electro-  
10                 absorption modulator that are substantially greater than 25 degrees  
11                 Celsius.
- 1     14. The electro-absorption modulated laser of claim 13 wherein the semiconductor  
2                 layer of the electro-absorption modulation comprises a multi-quantum well layer.
- 1     15. The electro-absorption modulated laser of claim 13 wherein the laser comprises a  
2                 distributed feedback semiconductor laser.
- 1     16. The electro-absorption modulated laser of claim 13 wherein the laser and the  
2                 electro-absorption modulator are integrated onto a single substrate.
- 1     17. The electro-absorption modulated laser of claim 13 wherein the laser and the  
2                 electro-absorption modulator are physically separate devices that are optically  
3                 coupled.
- 1     18. The electro-absorption modulated laser of claim 13 further comprising a  
2                 thermoelectric cooler that is in thermal communication with the laser.
- 1     19. The electro-absorption modulated laser of claim 18 wherein the thermoelectric  
2                 cooler adjusts the temperature of the laser to change a wavelength of the light  
3                 generated by the laser.
- 1     20. The electro-absorption modulated laser of claim 13 wherein a wavelength of the  
2                 light generated by the laser is substantially 1310nm.
- 1     21. The electro-absorption modulated laser of claim 13 wherein a wavelength of the  
2                 light generated by the laser is substantially 1550nm.

- 1       22. The electro-absorption modulated laser of claim 13 wherein a voltage sensitivity  
2                  with respect to wavelength of the electro-absorption modulator is substantially  
3                  the same as a voltage sensitivity with respect to wavelength of the laser.
- 1       23. The electro-absorption modulated laser of claim 13 wherein the material  
2                  composition of the semiconductor layer of the electro-absorption modulator is  
3                  chosen so that the semiconductor layer is substantially transparent to light  
4                  propagating though the semiconductor layer when a substantially zero or a  
5                  reverse bias voltage is applied across the semiconductor layer at operating  
6                  temperatures of the electro-absorption modulator that are substantially greater  
7                  than 35 degrees Celsius.
- 1       24. A transmitter for an optical communication system, the transmitter comprising:  
2  
3              a) a laser that generates light at an output;  
4  
5              b) an electro-absorption modulator having an electrically controllable  
6                  absorption, the electro-absorption modulator comprising a semiconductor  
7                  layer that is optically coupled to the output of the laser, a material  
8                  composition of the semiconductor layer being chosen so that the  
9                  semiconductor layer is substantially transparent to light propagating  
10                 though the semiconductor layer when a substantially zero or a reverse bias  
11                 voltage is applied across the semiconductor layer at operating  
12                 temperatures of the electro-absorption modulator that are substantially  
13                 greater than 25 degrees Celsius;  
14  
15              c) an electronic data modulator having an output that is electrically coupled  
16                 to a modulation input of the electro-absorption modulator, the electronic  
17                 data modulator generating an AC electrical modulation signal having a  
18                 peak-to-peak voltage amplitude that changes an absorption edge of the  
                semiconductor layer, thereby changing light transmission characteristics  
                of the electro-absorption modulator and modulating the light generated by  
                the laser;

- 19           d) a thermal sensor that is in thermal communication with at least one of the  
20           semiconductor layers of the electro-absorption modulator and the laser;  
21           and  
  
22           e) a temperature-driven controller having an input that is electrically coupled  
23           to the thermal sensor and an output that is electrically coupled to a DC  
24           bias control input of the electronic data modulator, the temperature-driven  
25           controller generating a signal that causes the electronic data modulator to  
26           change a DC bias voltage of the electrical AC modulation signal.

- 1       25. The transmitter of claim 24 wherein a wavelength of the light generated by the  
2           laser is substantially 1310nm.  
  
1       26. The transmitter of claim 24 wherein a wavelength of the light generated by the  
2           laser is substantially 1550nm wavelength.  
  
1       27. The transmitter of claim 24 wherein a voltage sensitivity with respect to  
2           wavelength of the electro-absorption modulator is substantially the same as a  
3           voltage sensitivity with respect to wavelength of the laser.  
  
1       28. The transmitter of claim 24 wherein the material composition of the  
2           semiconductor layer of the electro-absorption modulator is chosen so that the  
3           semiconductor layer is substantially transparent to light propagating though the  
4           semiconductor layer when a substantially zero or a reverse bias voltage is applied  
5           across the semiconductor layer at operating temperatures of the electro-absorption  
6           modulator that are substantially greater than 45 degrees Celsius.  
  
1       29. A method of generating data modulated light, the method comprising:  
  
2           a) generating light;  
  
3           b) propagating the light through a semiconductor layer having an electrically  
4           controllable absorption, a material composition of the semiconductor layer  
5           being chosen so that the semiconductor layer is substantially transparent  
6           to light propagating though the semiconductor layer when a substantially

7 zero or a reverse bias voltage is applied across the semiconductor layer at  
8 operating temperatures of the electro-absorption modulator that are  
9 substantially greater than 25 degrees Celsius;

10 c) elevating the temperature of the semiconductor layer above 25 degrees  
11 Celsius;

12 d) applying a DC reverse bias voltage across the semiconductor layer; and

13 e) applying an AC electrical modulation signal having a peak-to-peak  
14 voltage amplitude across the semiconductor layer, the modulation signal  
15 changing an absorption edge of the semiconductor layer, thereby  
16 modulating the light.

1 30. The method of claim 29 further comprising:

2 a) measuring a temperature of at least one of the semiconductor layers and a  
3 laser that generates the light; and

4 b) changing the DC reverse bias voltage across the semiconductor layer in  
5 response to the measured temperature.

1 31. The method of claim 29 further comprising:

2 a) measuring a temperature of at least one of the semiconductor layers and a  
3 laser that generates the light; and

4 b) changing a bias current driving a laser that generates the light in response  
5 to the measured temperature.

1 32. A method of tracking a temperature of an electro-absorption modulator to a  
2 temperature of a semiconductor laser, the method comprising:

3 a) generating light with a semiconductor laser;

4 b) propagating the light through an electro-absorption modulator comprising

- 5           a semiconductor layer having an electrically controllable absorption, a  
6           material composition of the semiconductor layer being chosen so that the  
7           semiconductor layer is substantially transparent to light propagating  
8           through the semiconductor layer when a substantially zero or a reverse bias  
9           voltage is applied across the semiconductor layer at operating  
10          temperatures of the electro-absorption modulator that are substantially  
11          greater than 25 degrees Celsius;
- 12         c) applying an AC modulation signal having a DC reverse bias voltage and a  
13           peak-to-peak voltage amplitude across the semiconductor layer, the  
14           modulation signal changing an absorption edge of the semiconductor  
15           layer, thereby changing light transmission characteristics of the electro-  
16           absorption modulator and modulating the light generated by the laser;  
17         d) measuring a temperature of the semiconductor laser that generates the  
18           light; and  
19         e) changing at least one of the DC reverse bias voltage and the peak-to-peak  
20           voltage amplitude of the electrical modulation signal, and a bias current  
21           through the laser in response to the measured temperature.